REMARKS

Claims 1-9 and 27 are pending herein. New claim 27 is added hereby.

1. Claims 1-9 were rejected under §103(a) over Imaeda et al. (assigned to the same assignee of the present application) in view Ciszek et al. This rejection is respectfully traversed.

In the Advisory Action, the PTO asserts three responsive points in reply to Applicants' arguments in the Request for Reconsideration. The present Amendment and RCE (along with a Rule 132 Declaration of Mr. Imai) are filed in response to the Advisory Action.

With respect to the first responsive point in the Advisory Action, the PTO maintains its position that Imaeda teaches that a high temperature gradient is not desirable **after** growing the single crystal, while Ciszek discloses cooling a **growing** body's interface (see Final Office Action, page 4). The PTO is apparently arguing that skilled artisans would have been motivated to employ Ciszek's step of blowing a cooling medium onto the liquid-solid crystal interface of an oxide single crystal grown using Imaeda's method, since Imaeda allegedly does not teach away from cooling the liquid-solid crystal interface. Applicants respectfully disagree.

Imaeda teaches maintaining an optimum temperature range (using a heater) after the growth of the crystal to prevent a rapid change in the temperature of the oxide single crystal. This optimum temperature range, Imaeda discloses, ensures that sufficient crystallinity of the oxide single crystals can be achieved by reducing thermal stresses that act upon the crystals and cause cracks in the oxide single crystals (see column 8, lines 1-6 of Imaeda). Ciszek, on the other hand, discloses blowing a cooling medium directly onto the liquid-solid crystal

interface while growing a silicon crystalline body.

Skilled artisans understand that the temperature at the liquid-solid interface portion of a crystal is higher than the temperature of the grown crystal body (see Mr. Imai's Declaration at paragraph 6). Accordingly, blowing a cooling medium directly onto the liquid-solid crystal interface portion necessarily produces a more rapid change in the temperature at the liquid-solid crystal interface portion than is realized when the same cooling medium is blown on the grown crystal body. Therefore, for the same reasons that Imaeda teaches that it is undesirable to have too high of a temperature gradient in the region of the cooler grown crystal body (thermal stresses result in poorer crystallinity), skilled artisans would understand that it is also undesirable to have too high of a temperature gradient at the hotter liquid-solid crystal interface portion (see Mr. Imai's Declaration at paragraph 6).

Based on the above, since Imaeda teaches that a low cooling rate is desirable after the oxide single crystal is grown for the purpose of providing good crystallinity, one of ordinary skill in the art would also know that a low cooling rate should be used at the solid-liquid crystal interface portion to ensure adequate crystallinity. Therefore, skilled artisans would not have been motivated to use Ciszek's step of blowing a cooling medium directly onto the liquid-solid crystal interface portion in Imaeda's method of forming oxide single crystals. Again, to do so would cause an even higher temperature gradient during the growth of the oxide single crystal, which, in turn, would likely cause cracking at the liquid-solid crystal interface portion of the oxide single crystals. The §103(a) rejection is erroneous for the above reasons alone.

Furthermore, as mentioned above, Ciszek's disclosure pertains to forming a ***silicon crystalline body***, while Imaeda discloses a method for producing ***oxide single crystals*** (as

claimed). A silicon crystal has a substantially higher coefficient of thermal conductivity (by more than 36 times) and a lower coefficient of thermal expansion in comparison to an oxide single crystal (see Mr. Imai's Declaration at paragraph 5)[1]. Accordingly, skilled artisans would not conclude that oxide single crystals could withstand the cooling treatment used in Ciszek, which is designed for silicon crystals. That is, because of the difference in the thermodynamic properties of oxide single crystals and silicon, skilled artisans would not conclude that Ciszek's cooling gas technique could be used directly to cool the oxide single crystal liquid-solid crystal interface portion in Imaeda (see Mr. Imai's Declaration at paragraph 6). There simply would be no reasonable expectation that benefits disclosed in Ciszek (i.e., wider crystal ribbons) would result if Ciszek's cooling step were employed in Imaeda's oxide single crystal growth method. Again, as discussed above, Imaeda's disclosure would lead one skilled in the art to expect a high temperature gradient at the liquid-solid interface of an oxide single crystal to yield a crystal with decreased crystallinity. Therefore, skilled artisans would not even look to the silicon-based disclosure in Ciszek for guidance when growing oxide single crystals as disclosed in Imaeda (and as claimed).

Ciszek also discloses cooling the ***liquid-solid crystal interface*** and does not disclose or suggest cooling ***only the solid portion of the crystal*** (i.e., the grown crystal body), as claimed in new claim 27. Therefore, even if Ciszek and Imaeda were combined as asserted in the Office Action (for the reasons explained above, skilled artisans would not have been motivated to do this), there still would be no step of directly cooling "only said oxide single crystal...," as recited in pending claim 27. Accordingly, new claim 27 is also allowable over

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[1] While the thermal expansion rate of oxide single crystals and silicon crystals are similar in the c-axis direction, oxide single crystals expand at a rate of three times more than silicon crystals in the a-axis direction. Therefore, skilled artisans understand that the overall thermal expansion rate for the anisotropic oxide single crystals is much larger in comparison to the isotropic silicon crystals.

the applied prior art of record.

In view of the foregoing, reconsideration and withdrawal of the §103(a) rejection over Imaeda et al. in view of Ciszek et al. are respectfully requested.

If the Examiner believes that contact with Applicants' attorney would be advantageous toward the disposition of this case, the Examiner is herein requested to call Applicants' attorney at the phone number noted below.

The Commissioner is hereby authorized to charge any additional fees associated with this communication or credit any overpayment to Deposit Account No. 50-1446.

Respectfully submitted,

April 10, 2003
Date

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Attachment:
Rule 132 Declaration of Katsuhiro Imai (11 pages)